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Asthma and obesity among 3 year old urban children: The role of sex and the home environment

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Abstract

Objective—To examine whether the relationship between obesity and asthma in young girls and boys can be explained by social and physical characteristics of the home environment. Study design We examined the relationship between asthma and obesity among children in the Fragile Families and Child Wellbeing study (N=1815). Asthma was determined through maternal report of asthma diagnosis by a doctor (active in past 12 months). Weight and height of child was measured during an in-home visit. Data on home social (maternal depression, intimate partner violence) and physical environmental factors (housing quality, tobacco exposure) were collected by questionnaire.

Results—Ten percent of children had active asthma, 19% were overweight and 17% were obese. In fully adjusted models, obese children had twice the odds of having asthma (OR 2.3 95%CI 1.5, 3.3) compared with children of normal body weight. In stratified analyses overweight boys, but not overweight girls, had an increased of odds of asthma. Obese boys and girls had an increased odds of asthma compared with boys and girls of normal body weight.

Conclusion—The relationship between asthma and obesity is present in boys and girls as young as 3 years of age, a relationship between being overweight and asthma is only present among boys. This relationship is not attributable to shared social and environmental factors of the children's home.

Keywords

obesity; asthma; child; gender; social environment

During the past decades the rates of childhood obesity and asthma have dramatically increased and low-income children are at higher risk for both conditions.1–3 US national

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estimates show a two-fold increased risk of current asthma among obese children younger than 16 years old. 4 However, there are inconsistent results of risk of asthma among obese boys and girls. A recent Australian study, conducted among preschool children 4–5 years of age, noted a significant relationship between obesity and asthma, among boys and girls.5 However, in the US, Skinner et al noted an association between asthma and being overweight or obese only among boys.6 Another study in school-aged children reported the same association but only among girls. 7 By adulthood, obese women and men are more likely than normal weight adults to suffer from co-morbid asthma.8¯9 Therefore, identifying risk factors and potential gender differences early in life may contribute to a better understanding of the mechanisms linking asthma and obesity.

Early exposure to psychosocial stressors 10 can result in the dysregulation of endocrine and autonomic processes (e.g., hypothalamic-pituitary-adrenal (HPA) axis, sympathetic-adrenal-medullary (SAM) system) which are hypothesized to increase the susceptibility to asthma and metabolic disorders. 11¯12 Research on both asthma and obesity show that exposure to physical and psychological insults during early life may be key for determining those at high-risk. 13¯16 Even though asthma and obesity are clearly distinct conditions, they share a number of risk factors. For example, physical aspects of the home environment such as parental smoking, 17¯18 housing deterioration and disarray are common risk factors for both asthma and obesity in children. 13،15 Similarly, psychosocial stressors such as neglect and domestic violence may also increase the risk of asthma and obesity.16، 19¯21 Other home social factors such as maternal depression have also been associated with both asthma and obesity. 22¯25 However, studies have not explored whether these various factors can account for the noted associations between asthma and obesity.

In this study, we examined the relationship between asthma and obesity among three-year old children enrolled in the Fragile Families and Child Wellbeing Study. We were specifically interested in determining whether multiple factors of the social and physical environment experienced at home explain the relationship between asthma and obesity among girls and boys very early in life.

Methods

Analyses were conducted using public-use data available from the Fragile Families and Child Wellbeing Study, a prospective birth cohort study that follows a sample of children from 20 large cities in the United States (US). Non-marital births were over-sampled relative to marital births in a ratio of 3 to 1. The study is a joint effort by Princeton University's Center for Research on Child Wellbeing (CRCW) and Center for Health and Wellbeing, Columbia University's Social Indicators Survey Center, and The National Center for Children and Families (NCCF) (http://www.fragilefamilies.princeton.edu). Details of the study design have been published. 26 In brief, 4898 women were recruited from 75 hospitals during the birth of the child in 20 US cities with populations over 200,000. Random samples of both married and unmarried births were selected until preset quotas were reached based on the percentage of non-marital births in the city that occurred at that hospital in 1996 or 1997. Among eligible mothers, 82% of those married and 87% of those unmarried agreed to participate. Mothers completed a baseline interview at delivery and participated in follow-up interviews when the children were approximately 12 and 36 months of age. At the time of the 36-month in-home assessment, 3288 families remained in the study with 2119 completing the study at home. 26 The analyses presented in this paper are restricted to children who completed the 36 month in-home assessment. Children were excluded if they were missing information on asthma diagnosis (N = 2), measured height and weight (N= 156) or other covariates of interest (N= 75). We also excluded children who were underweight (N= 85). The final sample for these analyses was N=1815. Those who did not

participate in the 36 month in- home assessment differed significantly from participants based on race/ethnicity and receipt of public assistance (Blacks, 38% non-participants vs. 55% participants $p < .0001$; public assistance, 31% non-participants vs. 41% participants $p < .0001$). The Fragile Families Study was approved by all 75 participating hospitals as well as the institutional review board (IRB) of Princeton University, New Jersey.

During the 36 month follow-up interview, mothers were asked whether a physician had diagnosed the child with asthma and, among those reporting asthma diagnoses, whether the child had an asthma attack in the past 12 months. This is the same definition employed by the National Center for Health Statistics. 27 In addition, parent-reported physician-diagnosed asthma is associated with outcomes such as airway hyper-responsiveness and more severe disease.28

Trained interviewers measured height and weight with participants wearing light clothing and no shoes during the 36 month follow-up interview. An electronic scale (SECA 840 Bella Digital Scale, Hanover, MD) was used to measure weight and a portable stadiometer (SECA 214 Road Rod Stadiometer) for height. Body mass index (BMI) was calculated from measured height and weight measured at the 36 month follow-up. The Center for Disease Control and Prevention (CDC) BMI growth reference 29 is used to determine age- and gender-specific BMI percentiles (BMIp) which are employed to categorize children as underweight (BMIp< 5^{th} percentile), normal weight (5^{th} ≤BMIp<85^{th}), overweight (85^{th}≤ BMIp<95^{th}) or obese (BMIp≥ 95^{th}).

Sociodemographic covariates include child's gender and race/ethnicity. Child race/ethnicity was defined based on the mother's information about her own race/ethnicity at baseline. Five categories were defined: (1) non-Hispanic White; (2) non-Hispanic African-American; (3) Hispanic (any race), non-Mexican; (4) Hispanic (any race) Mexican; and (5) other Race/ Ethnicity. Separate Hispanic Mexican and Hispanic non-Mexican categories were created due to the low rates of asthma among Mexicans vs. Hispanics of other origin. The information collected did not allow us to further define the Hispanic non-Mexican group. Marital status of the parents (married or not married at child's birth), maternal education at the 36 month follow-up (some college, high school graduate, less than high school), receipt of public assistance defined as receiving assistance at both baseline and the 36 month follow-up, and day-care enrollment at age 3 years were also considered. Child birth weight status (low birthweight defined as less than 2.5 kg) based on maternal report obtained at baseline was also considered. A validation study conducted in the Fragile Families and Child Well Being study revealed a high correlation ($r = 0.98$) between mothers report of the child's birthweight and medical record review. 30

Home Social Factors

Several social home environmental factors were studied based on previous literature documenting their relationship with obesity and asthma.

Maternal Depression—Maternal depression was ascertained based on the Composite International Diagnostic Interview - Short Form (CIDI-SF) 31 which generates a probable diagnosis of major depressive disorder, consistent with the Diagnostic and Statistical Manual of Mental Disorders – Fourth Edition. 32 This information was collected during the 12 and the 36 month follow-up interview. Maternal depression was characterized as no probable case of depression during the study period, probable case during the 12 or 36 month assessment, probable case during both the 12 and 36 month assessment.

Intimate Partner Violence—Intimate partner violence (IPV) was defined based on baseline and at the 12- and 36-month assessments, using previously validated questions

which varied slightly between baseline and follow-up assessments. 33–34 At baseline, mothers were asked to think about their relationship with the baby's father and asked how often does "he hit or slap you when he is angry?" Mothers who responded, 'often' or 'sometimes' as opposed to 'never' were categorized as experiencing baseline IPV. At 12 and 36 months, mothers were asked to think about their relationship with the baby's father or current partner and were then asked: "How often does he slap or kick you?", "How often does he hit you with a fist or object that could hurt you?", and "Were you ever cut or bruised or seriously hurt in a fight with the baby's father or current partner?". Mothers who responded 'often' or 'sometimes' as opposed to 'never' to either of the first two questions or who responded 'yes' to the third question were categorized as experiencing IPV for the relevant follow-up period. Physical IPV was characterized as: (a) not experiencing IPV during the study period (b) occurring prior to 12 months only (endorsed at baseline and/or 12-month follow-up), (c) occurring between 12 and 36 months only (endorsed at 36 months only), or (d) occurring both prior to 12 months and also between 12 and 36 months (chronic exposure).

Child Neglect—During the 36-month follow-up interview, mothers completed the Parent-Child Conflict Tactic Scales (PC-CTS) survey self reporting on acts of neglect towards their child 35. Prior to reading the questions the interviewer read the following statement to the mothers: "Sometimes things can get in the way of caring for your child the way you would like to: for example, money problems, personal problems, or having a lot to do." Neglect was assessed with five items which included: had to leave the child home alone, unable to get the child to a doctor or hospital when in need, too drunk or high to take care of the child, unable to feed the child, too caught up to show the child you loved him/her. For each item, mothers were asked how often they had engaged in such acts in the past year on a 7 point scale ranging from (0) never to (6) more than 20 times. Child neglect was considered positive if the mother responded any of the five events occurring once or more in the past year.

Home Environmental Factors

Housing Characteristics—At the 36 month in-home follow-up, trained interviewers conducted an assessment of indoor housing conditions. Housing deterioration was determined based on 11 questions on whether the home unit contained broken windows or cracked windowpanes, open cracks or holes in walls or ceiling, holes in floor, broken plaster or peeling paint, frayed electrical wires, presence of mice or rats, broken glass, falling plaster, broken stairs, peeling paint, and other hazards. Housing deterioration was considered as positive if one or more of the above was marked as present by the interviewer. Housing disarray was considered as positive if interviewers answered 'yes' to one or more of 6 questions regarding the organization of the home environment (i.e., is inside of home dark or crowded, cluttered or dirty/not reasonably cleaned, is house overly noisy- from noise in the house or from noise coming from the outside of the house). Housing quality items available in the Fragile Families and Child Wellbeing Study are consistent with items from previous work on housing conditions demonstrating links to psychological distress 13, 36–37.We have previously reported an association between housing disarray and asthma and between decay of the interior environment and deterioration of the exterior areas (surroundings and building) and child BMI z-scores in the current sample. 15, 38

Tobacco Exposure—Maternal smoking was based on mothers' report of whether they smoked during pregnancy at the baseline assessment. During follow-up assessments, mothers were asked to report on their current smoking status and whether anyone in the household smoked. Child tobacco smoke exposure was categorized as follows: (a) no exposure; (b) postnatal tobacco smoke exposure only; and (c) both *in utero* and postnatal

tobacco smoke exposure. There were very few children with *in utero* tobacco exposure but no postnatal exposure; hence they were included in the *in utero* and postnatal tobacco smoke exposure category.

Maternal factors considered were current use of maternal asthma medications at the 36 month follow-up, as an indicator of maternal history of asthma, and maternal BMI based on measured height and weight at the 36 month follow-up.

Data Analysis

The distribution of child relative weight, asthma and covariates was explored. Logistic regression analyses were conducted to estimate the association between obesity and asthma (dependent variable), adjusting for socio-demographic, home social and environmental factors (child's gender, race/ethnicity, low birth weight, maternal education, marital status, maternal age, public assistance, daycare attendance, maternal depression, intimate partner violence, child neglect, housing quality, and tobacco exposure). First, a regression model was run adjusting for socio-demographics factors only. Next, a second regression model was run adjusting for socio-demographic factors and home social factors. Lastly, a model further adjusted for home physical environmental factors was analyzed. Fully adjusted models were then stratified by gender and examined. To verify if the relationship between obesity and asthma would exclusively reflect maternal asthma, or obesity-related influences, a sensitivity analyses was conducted adjusting the final model for maternal use of asthma medication and maternal BMI. All analyses were conducted in SAS version 9.0 (SAS Institute, Cary, NC).

Results

Table I (available at www.jpeds.com) shows the distribution of child asthma and obesity, as well as study covariates. Ten percent of children had active asthma and 17% were obese at age 3. The sample comprises mostly African-American (55%) and Hispanic (23%) children. Because of the study design, only 28% of the parents were married, and 29% received public assistance. Frequent in children's home environments were parental smoking, (44%) [*in utero* and postnatal exposure (20%) and postnatal only (24%)], maternal depression (16%), IPV (18%) and child neglect (11%). About 15% of the children were living in a home with at least one indicator of deterioration, and 46% were in homes classified as disarrayed. A greater number of boys had active asthma (12%) compared with girls (8%), no differences were noted by gender and relative weight. In bivariate analyses between gender and the covariates of interest, boys were more likely to receive public assistance than girls (31% vs. 26%, respectively p=.01), no other differences in the distribution of covariates across genders were noted.

In unadjusted analysis of the total sample of children, being overweight was not significantly associated with asthma, but being obese was. This pattern was not substantially altered, and was statistically significant, even after considering demographic, social and physical environmental factors known to be related to both conditions according to previous literature (Table II). In the fully adjusted model, being overweight was not statistically significantly associated with asthma, 1.4 (95%CI 0.9, 2.1), and being obese was significantly associated with asthma 2.3 (95%CI 1.5, 3.3) (Table II). The adjusted analyses suggest that socio-demographic and home environment factors do not explain the association of interest, although they appear to have some impact on the magnitude of the association. Further adjustment by maternal use of asthma medication and maternal BMI did not substantially change the associations previously noted: overweight 1.4 (95% CI 0.9, 2.1) and obese 2.1 (95%CI 1.4, 3.1).

In stratified analyses (Table III), overweight girls had no asthma increase, but obese girls had increased odds of asthma compared with normal weight girls. Among boys, being overweight and being obese was significantly associated with increased odds for asthma compared with normal weight boys (OR 1.7 95%CI 1.0, 3.0 and OR 2.6 95%CI 1.5, 4.3, respectively). A formal test for interaction was not statistically significant. Furthermore, among girls, the unadjusted and adjusted odds ratio for the obesity and asthma association were practically identical and, among boys, the adjusted odds ratio was 29% higher than the unadjusted odds ratio.

Discussion

Our results indicate that obese three-year old children living in urban environments are significantly more likely to have asthma compared with non-obese children; however, this association is not attributable to home social and environmental factors. Gender differences were noted in that, overweight boys had increased odds of asthma compared with normal weight boys, however this association was not noted among overweight girls.

The association between asthma and obesity could be explained by one condition leading to the other. The most accepted notion is that obesity could facilitate asthma. Possible mechanisms include mechanical alterations in the respiratory system, chronic systemic inflammation, alteration of energy-regulating hormones (e.g. leptin) or comorbid diseases. 39 It is also conceivable, however, that asthma could result in obesity, for example through low levels of physical activity. Given the cross-sectional design of most analyses conducted to date, including ours, it is hard to determine the direction of the association.

Alternatively, the association between asthma and obesity could be the result of risk factors shared by both conditions. One of the main goals of our analysis was to understand if shared risk factors between asthma and obesity present in the home could potentially explain the association between the two conditions. We found no evidence that the association between obesity and asthma is simply a result of shared social and physical characteristics of the home environment. Although other studies have investigated relevant shared risk factors before, such as maternal smoking 18, we are unaware of any other studies which have included a wide range of potential home factors from IPV to child neglect. We also found no evidence that indicators of maternal asthma or obesity would explain the association between asthma and obesity among 3 year old children.

In this US sample of 3 year old children, gender differences in the association between asthma and obesity were not observed, however, gender differences in the association between being overweight and asthma were observed, but only among boys. Disagreement characterizes gender findings from prior studies which included children and pre-adolescents, with some studies reporting significant associations between obesity and asthma among both preschool boys and girls 5, and others among school-aged girls only 7 or among preschool boys only. 6, 40 It is possible that differences in population and, in particular, age, contribute to the difference in results. Our results are consistent with the recent Australian study among preschool children (4–5 years of age) where a positive relationship between asthma and obesity among both boys and girls was noted.5 Other studies of preschool children in the US did not report an association between obese girls and asthma as we found in our study.6, 40 Our sample mainly comprised of children of low socioeconomic status with a higher prevalence of obesity than reported in other studies which could have contributed to the different findings.

Study limitations need to be noted. As is typical with longitudinal studies, there was a reduction in the sample available from the original cohort over time. Although there was a

difference based on race/ethnicity between those who completed the 36-month assessment and those who did not, there were no differences based on maternal education, smoking status, low birthweight, or maternal IPV at baseline. Even though the Fragile Families Study included longitudinal information, the central study hypothesis (association between asthma and obesity) was tested cross-sectionally due mostly to incomplete data in the subsequent wave, which if used, would have restricted the sample size even more. By characterizing asthma as physician-diagnosed asthma by three years of age that has been active in the past year, we aimed to reduce the potential for misclassification of what is truly asthma. Our assumption is that children previously diagnosed with asthma without an attack in the past year may represent children with less severe underlying disease. Although we adjusted for a number of social and environmental factors not previously considered in the asthma and obesity association, it is possible the associations found could be partially attributed to unmeasured confounding. For example, even though we adjusted for housing features, we did not have information on presence of mold, indoor or outdoor air quality. However these factors are not directly related to obesity making it unlikely to be responsible for the associations noted. Lastly, there are characteristics of the neighborhood environment related to both asthma and obesity that were not considered in these analyses, such as neighborhood poverty and land use that should be considered in future studies 41⁻42. Despite these limitations our study has a number of strengths. Our analyses are based on a national sample of children mainly of low socioeconomic status, with objectively measured height and weight. We explored a variety of home social and environmental factors not previously considered in the relationship between asthma and obesity, and furthermore many of the factors considered were measured repeatedly throughout follow-up (e.g., maternal depression, intimate partner violence).

In this study, we examined the physical and behavioral landscape of households to better understand salient factors surrounding sex differences in the co-occurrence between obesity and asthma early in life. Our findings suggest that the obesity-asthma association is not attributable to social or physical factors in the home environment however, given limitations with the study, these results should be interpreted with caution. Future studies should explore longitudinally the role of the home environment as a modifier of the obesity and asthma association to examine whether specific factors exacerbate the development of asthma among obese children. In addition, other social factors, such as the neighborhood environment, not considered in these analyses should be studied. Furthermore a more detailed evaluation of the role genetics (besides crude indicators of presence of maternal asthma or obesity) and gene-environment interactions play in this association should also be studied. Despite our findings that the social and physical environment does not explain the relationship between asthma and obesity in early childhood, these findings should not be used as evidence to discontinue intervention efforts that address children's social and physical environment to improve children's health, as the home social and environmental factors considered in this study have been previously related to the risk of asthma and obesity in children.

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Table 1

Demographics, Fragile Families and Child Wellbeing Study (N=1815)

	Total Sample		Boys (N=959)		Girls (N=856)		p-value
	N	%	N	%	N	%	
Child Active Asthma at age 3	181	10.0	110	11.5	71	8.3	.024
Child relative weight at age 3							.186
Normal weight (5th ≤BMIp <85th)	1163	64.1	630	65.7	533	62.3	
Overweight (85th ≤BMIp <95th)	338	18.6	164	17.1	174	20.3	
Obese (BMIp≥95th)	314	17.3	165	17.2	149	17.4	
Socio-demographic Factors							
Race/Ethnicity							.699
White, non-Hispanic	343	18.9	170	17.7	173	20.2	
African-American, non-Hispanic	993	54.7	532	55.5	461	53.9	
Hispanic, any race, non-Mexican	166	9.15	92	9.6	74	8.6	
Hispanic, any race, Mexican	252	13.9	132	13.8	120	14.0	
Other	61	3.4	33	3.4	28	3.3	
Parents married	501	27.6	254	26.5	247	28.9	.260
Family on public assistance	520	28.7	299	31.2	221	25.8	.010
Maternal Education							.401
Some college	532	29.3	282	29.4	250	29.2	
High School Education	578	31.9	317	33.1	261	30.5	
Less than high school education	705	38.8	360	37.5	345	40.3	
Child enrolled in daycare	559	30.8	301	31.4	258	30.1	.567
Low birth weight	165	9.1	88	9.2	77	9.0	.894
Home Social Environment							
Maternal depression (probable)							
No maternal depression	1393	76.7	731	76.2	662	77.3	.854
Depression at 12 or 36 months	318	17.5	172	17.9	146	17.1	
Depression at both 12 and 36 months	104	5.7	56	5.8	48	5.6	
Intimate partner violence (IPV)							
No IPV	1489	82.0	785	81.9	704	82.2	.900

	Total Sample		Boys (N=959)		Girls (N=856)		p-value
IPV prior to 12 months	71	3.9	41	4.3	30	3.5	
IPV between 12 and 36 months	101	5.6	56	5.8	45	5.3	
IPV chronic	154	8.5	77	8.0	77	9.0	
Child neglect	204	11.2	112	11.7	92	10.8	.531
Home Physical Environment							
Housing deterioration	266	14.7	144	15.0	122	14.3	.646
Housing disarray	829	45.7	445	46.4	384	44.9	.510
Tobacco Exposure							
No in-utero or postnatal tobacco exposure	1020	56.2	544	56.8	475	55.5	.308
In utero and Post-natal Tobacco Smoke Exposure	363	20.0	179	18.7	184	21.5	
Post-natal Second Hand Smoke only	432	23.8	235	24.5	197	23.0	

* p values are based on Chi square tests between sex and covariates

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Table 2

Logistic regression results of the association between relative weight and asthma among 3 year-old children adjusting for covariates (N=1,815)

	Asthma							
	Model A		Model B		Model C		Model D	
	UOR	95%CI	AOR	95%CI	AOR	95%CI	AOR	95%CI
Relative Weight								
Normal weight (5th ≤BMIp <85th)	Reference		Reference		Reference		Reference	
Overweight (85th ≤BMIp <95th)	1.15	0.8, 1.7	1.30	0.9, 2.0	1.36	0.9, 2.1	1.36	0.9, 2.1
Obese (BMIp ≥95th)	1.92	1.3, 2.8	2.05	1.4, 3.0	2.20	1.5, 3.2	2.26	1.5, 3.3
Socio-Demographic Factors								
Sex: Girls			0.71	0.5, 1.0	0.72	0.5, 1.0	0.72	0.5, 1.0
Race/Ethnicity								
African-American			2.48	1.4, 4.4	2.33	1.3, 4.1	2.21	1.3, 4.0
Hispanic (any race), non-Mexican			2.63	1.3, 5.4	2.62	1.3, 5.4	2.50	1.2, 5.2
Hispanic (any race), Mexican			2.07	1.0, 4.3	2.10	1.0, 4.3	1.98	0.9, 4.2
Other			0.75	0.2, 3.4	0.76	0.2, 3.4	0.74	0.2, 3.4
Marital Status: married			0.63	0.4, 1.0	0.69	0.4, 1.1	0.70	0.4, 1.1
Family on public assistance: Yes			1.35	1.0, 1.9	1.39	1.0, 2.0	1.40	1.0, 2.0
Education								
High School			0.88	0.6, 1.3	0.92	0.6, 1.4	0.93	0.6, 1.4
Less than High School			0.88	0.6, 1.3	0.99	0.6, 1.5	1.00	0.6, 1.5
Maternal Age			1.00	1.0, 1.0	1.00	1.0, 1.0	1.00	1.0, 1.0
Child enrolled in daycare					1.59	1.1, 2.2	1.61	1.1, 2.3
Low birth weight					2.01	1.3, 3.2	2.00	1.3, 3.2
Home Social Factors								
Maternal depression								
Depression at 12 or 36 months					0.94	0.6, 1.4	0.94	0.6, 1.4
Depression at both 12 & 36 months					1.42	0.8, 2.6	1.36	0.7, 2.5
Intimate Partner Violence (IPV)								
IPV prior to 12 months					0.84	0.5, 1.5	0.88	0.5, 1.6
IPV between 12 and 36 months					1.33	0.7, 2.5	1.36	0.7, 2.5

	Asthma							
	Model A		Model B		Model C		Model D	
	UOR	95%CI	AOR	95%CI	AOR	95%CI	AOR	95%CI
IPV chronic					1.45	0.7, 2.9	1.47	0.7, 3.0
Child neglect					0.93	0.6, 1.5	0.95	0.6, 1.6
Home Environmental Factors								
Housing Deterioration							0.63	0.4, 1.0
Housing Disarray							1.47	1.0, 2.1
Tobacco Exposure								
In utero and Post-natal Exposure							0.87	0.6, 1.4
Postnatal exposure only							0.80	0.5, 1.2

UOR=Unadjusted odds ratio; AOR=Adjusted odds ratio; 95%CI=95% Confidence Interval Model A= unadjusted; Model B=adjusted by socio-demographic factors; Model C=adjusted by home social factors; and Model D=Adjusted by home environmental factors.

Table 3

Logistic regression results of the association between relative weight and asthma among 3 year old children, stratified by sex (N=1,815)

	Girls (N=856)		Boys (N=959)	
	OR	**95%CI**	**OR**	**95%CI**
Unadjusted Model				
Normal weight (5th ≤BMIp <85th)	Reference		Reference	
Overweight (85th ≤BMIp <95th)	0.94	0.9, 1.8	1.37	0.8, 2.3
Obese (BMIp≥95th)	1.96	1.1, 3.5	1.91	1.2, 3.1
Adjusted Model[1]				
Normal weight (5th ≤BMIp <85th)	Reference		Reference	
Overweight (85th ≤BMIp <95th)	1.03	0.5, 2.1	1.69	1.0, 3.0
Obese (BMIp≥95th)	1.97	1.1, 3.7	2.55	1.5, 4.3

[1]Model adjusted for child's sex and race/ethnicity, maternal education, maternal age, marital status, receipt of public assistance, daycare attendance, low birth weight, intimate partner violence, child neglect, maternal depression, tobacco exposure, housing deterioration and housing disarray.